A LIFE HISTORY STUDY OF THE ASH SEED WEEVILS, *THYSANOCNEMIS BISCHOFFI* BLATCHLEY AND *T. HELVOLA* LECONTE (COLEOPTERA: CURCULIONIDAE)[1]

JACK H. BARGER[2] AND RALPH H. DAVIDSON

Ohio State University, Columbus, Ohio

ABSTRACT

A life history study was made of the ash seed weevils, *Thysanocnemis bischoffi* Blatchley and *T. helvola* LeConte. Over-wintering occurs as larvae in ash seeds or in soil, with adults appearing in July and August. Adults soon deposit eggs within ash seeds, where larval development occurs. Only one generation per year was observed for each species.

Very little information on the life history of ash seed weevils is recorded in literature. *Thysanocnemis helvola* was described by LeConte (1876) from a female specimen collected in Illinois. He stated that these beetles were rare and that development took place in ash seeds. The range for this species, as given by Blatchley and Leng (1916), was from New Jersey and Ontario to Illinois, south to Kentucky and the District of Columbia. *Thysanocnemis bischoffi* was described by Blatchley (1916) from specimens collected in Marion County, Indiana, Bowmanville, Illinois, and Bloomsburg, New Jersey. Knull (1932) reported that seeds of white ash were infested with larvae of *T. bischoffi* in Franklin County, Pennsylvania. He also reported that, in the spring after the seeds had fallen to the ground, the larvae crawled from them into the soil. The exact distribution of this species has not been determined, but the few records available indicate a rather wide range from New Jersey to the Mississippi River, in areas where ash trees grow.

T. bischoffi is often confused with *T. fraxini* LeConte, which also breeds in ash seeds and has the same general body characteristics and coloration. Males of *T. fraxini* can be distinguished by a silky fringe of hair on the front tibiae; this fringe is absent in males of *T. bischoffi*.

Blatchley and Leng (1916) stated that the fifth ventral segment of *T. bischoffi* was not impressed. This is true for females, but males have this segment medially impressed. This character difference has been used successfully in sexing beetles

[1]Manuscript received September 29, 1966.

[2]Now with the U.S.D.A. Forest Service Laboratory, Delaware, Ohio.

of both *T. helvola* and *T. bischoffi*. Adults and larvae of both species, together with egg-laying scars in ash seeds are illustrated in figure 1.

Specimens were collected from *Fraxinus americana* Linnaeus in Delaware County, Ohio, on August 25, 1961, by spreading a large tarpaulin under an ash tree and jarring the branches with a pole. It was possible to collect 50 to 60 adults in about 5 minutes. These were determined to be *T. bischoffi* and *T. helvola* by Rose E. Warner of the Insect Identification and Parasite Introduction Branch of the U. S. Department of Agriculture.

Collected adults were separated according to species, placed in 3 x 6 inch plastic covered containers, together with white ash seeds, and observed for oviposition behavior. Each species exhibited essentially the same technique of preparation for egg deposition. The weevils grasped the seed and drilled through the seed coat by up-and-down and back-and-forth motions. Most weevils stopped drilling holes when their snout was approximately two-thirds into the seed, though

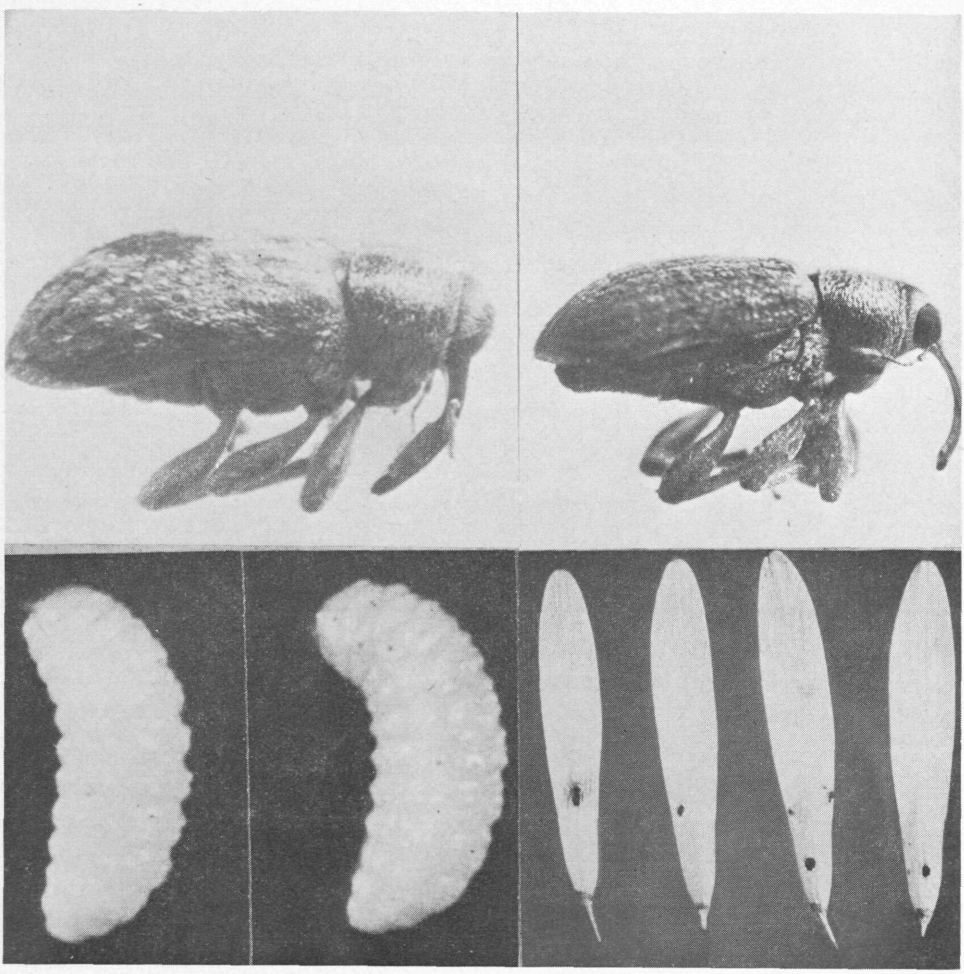

FIGURE 1. Adult of *Thysanocnemis bischoffi* (top, left); adult of *T. helvola* (top, right); larvae (bottom, left); egg-laying scars in seeds (bottom, right). Adults of *T. bischoffi* vary in length from 3.2 to 4 mm; for *T. helvola* from 3.3 to 3.8 mm. All figures greatly enlarged except the seeds.

on a few occasions, some weevils were observed with their snout completely embedded in the seed. Some weevils walked around in a circle with the snout inserted in the seed. After the hole was bored, the female turned around and deposited an egg inside. This usually required from 2 to 5 minutes, with only one egg being placed in each hole, for those observed. The eggs of *T. bischoffi* and *T. helvola* are 0.2 mm in diameter, clear, and globular when laid.

The incubation period was observed for each species by watching females ovipositing, then removing the seeds and recording the time that elapsed between oviposition and hatching. Fifty seeds were checked for each species. These seeds were maintained under laboratory conditions of 26 C and a relative humidity of 50 to 55 per cent. Great care was required during the observing process by which the incubation period was determined, because the eggs desiccate rapidly if removed from the seeds. The seed coat was cut away about 4 mm from the oviposition scar and peeled back for observation. A 15-watt fluorescent lamp was employed in this procedure because very little heat is produced by this light source. After completing an observation, the seed coat was replaced to avoid unnecessary water loss. Observations were made over a period of two weeks approximately every 8 hours.

For *T. bischoffi* the average incubation period was 1.75 days with 94 per cent hatch, whereas for *T. helvola* the average incubation period was 2.25 days with 98 per cent hatch. Even though the average incubation period of the two species varied only 12 hours, this difference appeared significant because the conditions under which the comparison was made were identical. The difference in percentage hatch would have resulted from egg damage during the observation periods.

Knull (1932) had determined seed infestation to be 7.3 per cent by sampling from the top, middle, and lower parts of trees in Franklin County, Pennsylvania; the highest infestation was from the lower portion where it was found to be 11.3 per cent. In this study, the degree of infestation was determined by collecting over 24,000 ash seeds, from which a random sample of 3,840 was examined for oviposition scars. Slightly over 44 per cent of the seeds were infested with larvae of either *T. bischoffi* or *T. helvola*.

The larvae were typical for members of the family Curculionidae: white with slightly curved bodies and brown heads. To determine the number of larval instars, a large quantity of ash seeds was collected on September 3, 1961, and each week following that date some were opened, the larvae removed and placed in 70 per cent alcohol. In most cases, 5 to 10 larvae were removed during each sampling period to insure that all instars would be collected. No characteristics were found which could be used to differentiate the two species of larvae. Head capsule measurements of 173 larvae showed variation of from 0.267 mm for the smallest instars to 0.666 mm for the largest. The head capsule of both species was the same size at maturity. Dyar's (1890) method for determination of instars was employed without success. However, by plotting graphically, using head width as the abscissa and the number of larvae with the same head width as the ordinate, six peaks were obtained, indicating there are 6 larval instars for each species. The actual number of instars for weevils has not been studied extensively. Cartwright (1929) reported 5 or 6 instars for the maize billbug.

The amount of food present in ash seeds varies greatly because of variation in seed development. Some larvae emerging from seeds were twice as large as others, indicating variability in food supply, but their head capsules were always the same size. When abundant feeding material was available in the seeds, the larvae remained inside 4 or 5 months longer than those developing in imperfect seeds. After larval emergence, many seeds from which they had come were opened, and in no instance was any food material left; even the cast skins of past larval instars were pulverized. Apparently larvae remain in seeds as long as there is sufficient food.

Several thousand seeds were kept indoors (26C, 50 to 55 per cent R.H.) during the coldest winter months, with the hope that development would be accelerated. However, during these months no larvae emerged, so on March 1, 1962, the container of seeds was moved outside to a position in a covered carport where the temperature was often as high as 27C on sunny days. On March 22, 1962, the first larvae emerged from these seeds; this continued until May 15, 1962, when the last observed emergence occurred. These larvae were collected and groups of 10 to 50 were placed in small jars partially filled with a sterilized moistened soil mixture consisting of 1 part sand, 1 part peat moss, and 1 part loam soil. Within 30 minutes all larvae had disappeared beneath the surface. The jars were then stored in a basement laboratory where the temperature ranged from 24 to 26C.

After discovery of adults on the soil surface in some jars, the contents of all jars were emptied into petri dishes containing a thin layer of the same soil mixture, so that daily observations could be made more easily. It was found that commencement of pupation could be determined by simply watching the activity of the larvae. The rhythmic counter-clockwise circular motion of the abdomen began just before the pupal period. This movement also continued throughout most of the pupal period unless the pupa was disturbed, in which cases erratic movement sometimes resulted in clockwise motion for 20 to 30 seconds, after which counter-clockwise motion was resumed. Some pupae continued the counter-clockwise motion for periods up to 24 hours. This activity greatly enlarged the soil chambers of the pupae. After 4 to 5 days of almost ceaseless movement, the pupae displayed inactive periods, which often lasted several days. In order to check on this activity, small bits of soil were placed on the abdomen in such a precarious position that any movement would topple them. In most cases, the motion became violent again two or three days before the appearance of the adults and lasted until adult emergence was nearly complete.

New pupae were without pigmentation, though they gradually darkened with age in the region of the elytra. The most notable change occurred in the eyes, which darkened to light brown in five days and to black in ten days. This darkening of the eyes was found to be a good indicator that adult emergence would occur in about three days.

Adult emergence, at temperatures of 24 to 26C, usually occurred 12 days after pupation began. Newly emerged adults were sluggish and light in color. However, their snouts became much darker after a period of 24 hours, and the entire insect darkened to their normal intensity of pigmentation in 3 days.

Following emergence from pupae, adults spent an average of 3 to 4 days in the soil chambers before crawling to the surface. Adults reared from pupae placed in petri dishes could not walk or fly normally, and were unable to roll over, when placed dorsal side down, until after they were 2 or 3 days old. This additional period in the old pupal cell results in the adults gaining strength necessary for walking and flying properly.

New adults were placed in petri dishes together with old ash seeds as food. It was found that the seed coats were too hard for any of the weevils to penetrate. After removing the seed coat, a few weevils bored holes in the seeds, but none oviposited. English walnuts, fresh peach slices, fresh ash leaves and twigs were offered the new weevils, but feeding success occurred only with peach slices and walnuts.

The first weevils to emerge, of those in the jars kept in the laboratory, were *T. bischoffi*. They appeared on May 21, 1962, from larvae that had emerged from seeds on March 29, 1962. In outdoor cages, the first adult appeared on June 29, 1962; the next adults appeared on July 2, 1962, and emergence continued almost daily thereafter. The greatest emergence of adults appears to occur at a time which corresponds to the development of seeds on ash trees.

The first adults of *T. helvola* appeared in jars held in the laboratory on June

26, 1962. They came from larvae that had emerged from seeds on March 29, 1962. Adults continued to emerge daily thereafter. The first adult to appear in outdoor cages was on August 1, 1962. In general, the emergence date for *T. helvola*, either in the laboratory or outdoors, was approximately 36 days later than that of *T. bischoffi*.

Sixty adults of each species of ash seed weevils were collected on August 30, 1961, and placed in groups of 5 in 12 plastic containers. These containers were then supplied with different materials: ash seeds and water, ash seeds, water, ash twig in water, or no food or water. Two sets of each were prepared; one set was kept in the laboratory (at 26C, 50 to 55 per cent R.H.) and the other outdoors (average temperature of 24C from August 30, 1961 to September 17, 1961). The nature of the food or water supplied the weevils had no effect on their longevity. However, the life span for weevils held in the laboratory averaged about 14 days, whereas those kept outdoors averaged 10.5 days. Because these adults had already lived an undetermined period of time before being collected it was not possible to determine their total life span. No adults of either species were found in any ash trees after the first heavy frost in autumn.

Because the first adult emergences are early July for *T. bischoffi* and in August for *T. helvola*, it is presumed that weevils are present throughout these summer months. Death is inferred to occur at the time of the first severe frost in autumn. Both species overwinter as larva, either inside ash seeds or in the soil.

Five hymenopterous parasites were found in the rearing jars and were identified by B. D. Burks, U. S. National Museum, as *Paracrias mirus* (Girault), family Eulophidae, and *Triaspis ocellulata* Martin, family Braconidae. The latter species was previously known to be a parasite of ash seed weevils. At the time of this study, parasitism cannot be considered to be an important check on populations of *T. bischoffi* and *T. helvola*.

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